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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/992,743	11/14/2001	Ende Shan	46890/DMC/V165	9896

23363 7590 06/18/2003

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EXAMINER

PERALTA, GINETTE

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 06/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/992,743

Applicant(s)

SHAN, ENDE

Examiner

Ginette Peralta

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 June 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7,9-26 and 28-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7,9-26,28-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/22/03 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-7, 9-26, and 28-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shan et al. (U. S. Pat. 6,140,228) in view of Yang et al. (U. S. Pub. No. 2001/0045661 A1).

Regarding claims 1 and 21, Shan et al. discloses in cols. 5-8 a process that comprises depositing a metal liner layer 3 on a semiconductor device including an aperture; depositing a seed layer of aluminum on the metal liner layer with the

temperature of the semiconductor device below 300°C (col. 6, ll. 31-42); depositing aluminum on the seed layer, with the temperature of the semiconductor device being greater than 350°C to fill the aperture, whereby the aperture is substantially filled, creating a via (col. 7, l. 15-col. 8, l. 65).

Shan et al. discloses the claimed invention with the exception of exposing the seed layer of aluminum to a reactive gas.

Lai et al. teaches in col. 5, lines 25-67, a process of filling trenches and vias with aluminum that includes the steps of depositing a metal liner layer on a semiconductor device, depositing a seed layer for aluminum on the metal liner layer, and exposing the seed layer to a reactive gas comprising oxygen for the disclosed intended purpose of depositing aluminum on the seed layer to fill the aperture, whereby the aperture is substantially filled, and the aluminum deposited having greater surface smoothness, and being void free, halogen free and providing an excellent electrically conductive pathway.

Thus, it would have been obvious to one of ordinary skill in the art to expose the seed layer to a reactive gas such as the one contained in the deposition taught by Lai et al. for the disclosed intended purpose of depositing a void free, halogen free aluminum fill in the trench and vias in the invention of Shan et al. Furthermore, it would have been obvious to one of ordinary skill in the art to vary the temperature ranges, and conditions of the atmosphere of the chamber since it has been held that where the

general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claims 2 and 22, Shan et al. discloses a via that couples a plurality of metal layers through one or more dielectrics (col. 9, ll. 30-41).

Regarding claims 3 and 23, Shan et al. discloses depositing a metal liner layer into the via and onto the surface of a dielectric layer that the via is formed in, the metal liner layer forming a substantially continuous film throughout the topography of the via.

Regarding claims 4-6 and 24, Shan et al. discloses that the metal liner layer comprises a titanium based compound, and among them, titanium nitride (col. 5, ll. 52-59).

Regarding claims 7 and 26, both Shan et al. and Lai et al. disclose the temperatures at or below 600°C, furthermore Shan et al. discloses the temperature of deposition of about 300 to 420°C, this temperature preventing the amalgamation of the seed layer.

Regarding claims 9 and 28, Shan et al. discloses that the seed layer is deposited at a temperature within the range of 180 to 220°C. It would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the temperature within the range taught by Shan et al., since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. Furthermore, it

would have been obvious to one of ordinary skill in the art at the time the invention was made to use a temperature within the range taught by Shan et al. as there is no statement denoting the criticality of using temperatures outside the range taught by Shan et al..

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claims 10 and 29-30, Shan et al. as modified by Lai et al. above discloses exposing the seed layer of aluminum to an atmosphere containing a mixture of reactive gases and inert gases, as shown in Lai et al.'s col. 5, ll. 32-60.

Regarding claims 11-12 and 31, Shan et al. as modified by Lai et al. discloses that the atmosphere contains oxygen mixed with argon.

Regarding claims 13-20 and 32-39, Shan et al. as modified by Lai et al. discloses that oxygen is present due to the metallorganic precursor used at a pressure of about 0.001 to 100 torr and for 0.01 up to 100 minutes, and that due to this the atmosphere contains less than about 50% oxygen by weight, the pressure of oxygen would be less than 10mtorr, the time of exposure can be varied, and the deposition of the aluminum layer is at a temperature between about 300 to 470°C. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a

temperature, a concentration, and a time within the ranges taught by Shan et al. as there is no statement denoting the criticality of using temperatures, concentrations, and ranges outside the ranges taught by Shan et al..

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 25, Shan et al. discloses depositing a layer of aluminum on the metal liner layer such that the seed layer forms a substantially continuous layer throughout the surfaces of the apertures and the semiconductor device and the semiconductor device.

Regarding claim 40, Shan et al. teaches in Cols. 5-8 a process of forming vias on a semiconductor device that comprises depositing a metal liner layer 3, depositing a seed layer of aluminum 4 on the metal liner layer 3, and depositing aluminum on the seed layer to fill the aperture, and wherein the vias and trenches that can be filled with this process have a width of less than 0.5μ and preferably less than 0.25μ , and having an aspect ratio of 2:1 or greater, or preferably 3:1 or greater with the substantial absence of voids.

Shan et al. discloses the claimed invention with the exception of exposing the seed layer of aluminum to a reactive gas.

Lai et al. teaches in col. 5, lines 25-67, a process of filling trenches and vias with aluminum that includes the steps of depositing a metal liner layer on a semiconductor device, depositing a seed layer for aluminum on the metal liner layer, and exposing the seed layer to a reactive gas comprising oxygen for the disclosed intended purpose of depositing aluminum on the seed layer to fill the aperture, whereby the aperture is substantially filled, and the aluminum deposited having greater surface smoothness, and being void free, halogen free and providing an excellent electrically conductive pathway.

Thus, it would have been obvious to one of ordinary skill in the art to expose the seed layer to a reactive gas such as the one contained in the deposition taught by Lai et al. for the disclosed intended purpose of depositing a void free, halogen free aluminum fill in the trench and vias in the invention of Shan et al. Furthermore, it would have been obvious to one of ordinary skill in the art to vary the temperature ranges, and conditions of the atmosphere of the chamber since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703) 305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

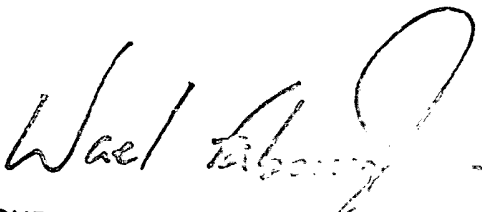
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for

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the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

GP
June 14, 2002


SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER 2800